Patent [Application] 2001-133064

[Document Name] Specifications

[Title of the Invention] Porous Polymer Particle, Alkali-Resistant Anion Exchanger, Its Manufacturing Method, Ion Chromatography-Use Column and Anion Measurement Method

[Claims]

[Claim 1] A porous polymer particle that is characterized by a nitrogen containing heterocyclic group, which contains a quaternary ammonium structure, being bonded to an alkali-resistant polymer substrate by means of a spacer.

[Claim 2] A porous polymer particle as described in Claims 1 wherein a nitrogen containing heterocyclic group that contains a quaternary ammonium structure is derived from an aromatic or non-aromatic nitrogen containing heterocyclic compound.

[Claim 3] A porous polymer particle as described in Claim 2 wherein the nitrogen containing heterocyclic compound is a compound which can be selected from a group comprised of a pyridine compound that is represented by Formula (1)

[Chemical 1]

(In the formula, R represents an alkyl group or an alkoxy

group of carbon number 1~5 that is also desirable when substituted by a hydroxyl group or halogen atom, or a halogen atom and m is an integer of 0~5. The plurality of R may be the same or different when m is 2 or more.),

a 1-alkylpyrrolidine compound that can be represented by Formula (2)

[Chemical 2]

(In the formula, R represents an alkyl group of carbon number 1~5 that is also desirable when substituted by a hydroxyl group or a halogen group, R^1 represents an alkyl group or an alkoxy group of carbon number 1~5 that is also desirable when substituted by a hydroxyl group and n is an integer of 0~2.),

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a 1-alkylpiperidine that is represented by Formula (3)

[Chemical 3]

(In the formula, R represents an alkyl group of carbon number 1~5 that is also desirable when substituted by a hydroxyl group or a halogen atom, R^1 represents a hydroxyl group or an alkyl group or an alkoxy group of carbon number 1~5 that is also desirable when substituted by a hydroxyl group, and p is an integer of 0~2.),

and a 1, 4-dialkylpiperidine compound that is represented by

Formula (4)

[Chemical 4]

(In the formula, R^2 and R^3 can be identical or different and, respectively, are hydrogen atoms, or alkyl groups of carbon number 1~5 that are also desirable when substituted by a hydroxyl group or halogen atom. However, R^2 and R^3 do not simultaneously represent hydrogen atoms.)

[Claim 4] A porous polymer particle as described in Claim 3 wherein a nitrogen-containing heterocyclic compound is pyridine, 2-methylpyridine, 3-methylpyridine, 4-methylpyridine, 2-hydroxy-4-methylpyridine, 2-hydroxy-6-methylpyridine, 2-hydroxypyridine, 3-hydroxypyridine, 4-hydroxypyridine, 1-methylpyrrolidine, 1-ethylpyrrolidine, 1-methylpiperidine, 1-ethylpiperidine, 1-(2-hydroxyethyl)piperidine, 1-(hydroxymethyl)piperidine, 1-(2-hydroxyethyl)pyrrolidine, 2-(2-hydroxyethyl)-1-methylpyrrolidine, 3-hydroxy-1-methylpiperidine, 4-hydroxy-1-methylpiperidine, 4-chloro-1-methylpiperidine, 1-(2-chloroethyl)piperidine, 1-(2-chloroethyl)pyrrolidine, 1-methylpiperidine,

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1-ethylpiperidine or 1, 4-dimethylpiperidine.

[Claim 5] A porous polymer particle as described in any of Claims 1 through 4 wherein the aforementioned porous polymer particle substrate is selected from poly(vinyl alcohol) type

copolymers and styrene/divinylbenzene type copolymers, the spacer molecule that connects the substrate and ion exchange group is a compound which contains a glycidyl group, and the aforementioned polymer is bonded with the spacer by means of a bond that does not cleave under alkali conditions.

[Claim 6] A porous polymer particle as described in any of Claims 1 through 5 that has an average particle size of 1~30 μm.

[Claim 7] A porous polymer particle as described in any of Claims 1 through 6 that has an average pore size of 50~300 Å.

[Claim 8] An alkali-resistant anion exchanger that is made from a porous polymer particle as described in any of Claims 1 through 7.

[Claim 9] An alkali-resistant anion exchanger manufacturing method that is characterized by a spacer molecule that contains a glycidyl group being bonded to an alkali-resistant polymer porous particle that is selected from poly(vinyl alcohol) type copolymers and styrene/divinylbenzene type copolymers by means of a bond which does not cleave under alkali conditions, and the introduction of an anion exchange group by reacting a nitrogen containing heterocyclic compound with the aforementioned glycidyl group.

[Claim 10] An alkali-resistant anion exchanger as described in Claim 9 wherein a nitrogen containing heterocyclic compound is selected from the nitrogen containing heterocyclic compounds that are described in Claims 2 or 3.

[Claim 11] An alkali-resistant anion exchanger manufacturing method as described in Claim 10 that is characterized

by a compound containing 2 or more glycidyl groups within the molecule being reacted with a poly(vinyl alcohol) type copolymer which is obtained by saponifying and partially converting a copolymer of a vinyl carboxylate and an isocyanurate type cross-linking monomer into a hydroxyl group, introducing a glycidyl group containing group such as the mass after the reaction becoming 103~140 when the mass of the aforementioned poly(vinyl alcohol) type copolymer is 100, and a nitrogen containing heterocyclic group being reacted with this.

[Claim 12] An alkali-resistant anion exchanger manufacturing method as described in Claim 11 with saponification of a poly(vinyl alcohol) type polymer

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performed until 0.5~5 meq/g of hydroxyl group is produced in the polymer.

[Claim 13] A suppressor system ion chromatography column-use packing that is made from an anion exchanger as described in Claim 8.

[Claim 14] A suppressor system ion chromatography-use column that is packed with anion exchanger as described in Claim 8.

[Claim 15] An anion measurement method by suppressor system ion chromatography with a column as described in Claim 14 and an alkali eluent used in combination.

[Claim 16] An anion measurement method as described in claim 15 wherein an alkali eluent is a hydroxide type eluent.

[Claim 17] An anion measurement method as described in

Claim 16 that uses a hydroxide type eluent at an isocratic condition of 20 mM or less as an alkali eluent.

[Claim 18] An anion measurement method as described in any of Claims 15 through 17 that is characterized by being used for measuring halogen oxide ions.

[Claim 19] An anion measurement method for non-suppressor system ion chromatography that is characterized by using a column packed with an anion exchanger as described in Claim 8 for measuring halogen oxide ions.

[Claim 20] An anion measurement method as described in Claim 18 or 19 wherein the halogen oxide ions are chlorite ions, chlorate ions and/or bromate ions.

[Claim 21] An anion measurement method as described in any of Claims 15 through 20 that is characterized by simultaneous measurement of the halogen oxide ions with anions that can be selected from a group comprised of fluoride ions, chloride ions, nitrite ions, bromide ions, nitrate ions, phosphate ions and sulfate ions.

[Claim 22] An anion measurement method as described in any of Claims 18 through 21 wherein the separation degree of the chlorite ions and bromate ions and the separation degree of the chlorate ions and the bromide ions, is 1.5 or greater.

[Claim 23] An anion measurement method as described in any of Claims 15 through 22 that is characterized by the fluoride ion peak not being superposed with the water dip position.

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